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COMPARATIVE STUDY ON THE PRODUCTION PARAMETERS, ANIMAL HEALTH STATUS AND DRUG COSTS ON A COMMERCIAL DAIRY FARM

Author(s):
L. Ózsvári[1] – I. Buvár[1] – Á. Bartha[2] – Cs. Fogarassy[2]

Affiliation:
[1]University of Veterinary Medicine Budapest, Department of Veterinary Forensics, Law and Economics, H-1078 Budapest, István street 2
[2]Szent István University, Faculty of Economics and Social Sciences, Climate Change Economics Research Centre, H-2100 Gödöllő, Hungary, Páter Károly street 1

Email address:
ozsvari.laszlo@univet.hu, buvar.istvan@univet.hu, akos.bartha@gmail.com, fogarassy.csaba@gtk.szie.hu

Abstract

The ever-changing economic criteria system of the last 25 years proved to be a challenge for the Hungarian husbandry. The Regime Change, entry into the European Union, and the current trend of market globalisation cause changes and uncertainty. This results in significant tasks for experts working in the farm management. The vet profession prefers prevention instead of the classic curative activities. Knowing the technological solutions of farms is required for all these. Also, production indices and costs have to be followed in order to realise animal health management that produces an income. The dairy farm in the current analysis can be said to be sufficient in terms of animal health, taking the domestic level of herd health into consideration - and excluding calf healthcare. Furthermore, the costs of livestock drugs generate a return quickly. Based on the data of the analysis, the total specific costs of drugs are an average 23,582 HUF for each cow annually. This generated a return for an excess milk of 237.8 per cow annually. Naturally, the continuously growing market price of milk also influenced the return, which is a somewhat confusing economic circumstance, in regards to the financial efficiency of drug usage.

Keywords

animal health, drug costs, dairy production, cost-benefit analysis

1. Introduction

The ultimate goal of those who own dairy farms is to sustain the long-term profitability of their property. Therefore, they have to adapt to market demands. The Regime Change, entry into the European Union, and the current trend of market globalisation cause changes and uncertainty. This results in significant tasks for experts working in the farm management. The vet profession prefers prevention instead of the classic curative activities. Knowing the technological solutions of farms is required for all these. Also, production indices and costs have to be followed in order to realise animal health management that produces an income. The consumer and market demands are always changing, and adapting to them requires quickly executed technological changes. The fastest to react are the ones to stay standing on the market. This can only work if experts can measure expected effects during their decisions as accurately as possible, and to the greatest possible detail. Managing dairy farms demands more and more economic-related knowledge from vets, and for them to measure the consequences of their decisions on animal health. The current study aims to comparatively analyse a commercial dairy farm's production indices, animal health state and drug usage.

2. The general economic environment of bovine husbandry

2.1. Most notable changes in the dairy cow sector

In 2000, the Hungarian dairy farms gave 11-12% of the total agricultural production [1], but grew until 20% by

2012 [2]. In other words, their economic role is a very important one in agriculture. The bovine husbandry of nations, which have a modern agriculture, underwent significant changes. In spite of the constant decrease of the livestock numbers, the milk yield per cow constantly increased. This was caused by the development of genetics, and the modernisation of farm technological solutions. Though the number of dairy farms decreased, their average number of livestock increased, which means the herd size became large. The cost-intensity of modern technologies is very high, which significantly increased the amount of capital the sector needs. At the same time, the work of vets changed fundamentally as well: preventing herd health problems became the most important, by which the production of the farm can be increased [3].

2.2. Main factors determining the profit of bovine husbandry

Profit is determined by the costs and returns of production, and most notably the milk price in our case. The quantity and quality of produced milk is influenced by many factors, some of which are: the genetics, the housing technology, the herd size, the level of feeding, the rate of culling, the state of reproduction, and the animal health management. These all determine production costs which might be decreased by high-tech information technology, good farm management including efficient planning, determined and accurate employees. However, costs related to environmental protection (f. e. manure handling) and animal protection are unavoidable, due to the European Union regulations. Apart from the milk sales, calves, breeding animals, culled cows, and manure can also generate some income. If we subtract the fixed and variable production costs from the income, we get the profits [3].

2.3. Effects of diseases on the production of the dairy farm

Ferenc Kovács said the following in 1975: "an animal is healthy, if it can produce according to its genetic capacity, within the confines of being economically sound". Multifactoral diseases are caused by many correlated factors, and the general symptom of the disease is made up of the pathogens, however, risk factors do have a significant role to play, e.g. housing and feeding disorders. The most notable economic losses of dairy farming are caused by mastitis, reproductive disorders, lameness, and respiratory diseases (BRDC) [3]. Multifactoral diseases can be efficiently avoided by animal health programmes based on environmental checks [4].

2.4. Production indices and drug costs of dairy farms

Animal health technology significantly influences the production indices and drug costs of dairy farms. It's a fact that prevention is always cheaper than the curation of already existing diseases [3, 5]. Ózsvári et al. [6] compared the production indices (the quantity of marketed milk, progeny and mortality and culling rate) to animal health drug costs. They categorized the drug costs based on product groups and indication. Most of the costs were made up of drugs used to treat mastitis (45% and 50%, respectively) for two dairies, and to treat fertility problems (40%) for a third one. The costs of antibiotics were the most notable for all three farms (46.8% on average). If we take a look at the costs of antibiotics by indication, we can see that for all three herds, the antibiotics used for mastitis were the most costly (72.7% on average). The average costs of vaccines amounted to 9.5%, whereas those of disinfectants to 8.9%, hormones to 12.3%, and vitamins - nutrient supplements to 11.6%. Ózsvári et al. [6] calculated that the annual drug costs for a cow amount to an average of 10.560 HUF, the specific drug costs for mastitis to an average of 0.6l HUF/1/year, and the specific drug costs for reproduction disorders to an average of 2,425 HUF/calf/year for the three farms. The costs of drugs used for udder treatment generate a return in case of an annual surplus of 70 litres milk produced for each cow. The drug costs spent on reproduction disorders generate a return in case of an annual 0.043 extra calf for each cow.

Varga and Ózsvári [7] compared the production indices of a dairy farm with the vet drug costs for the 2000-2002 period. Out of the production indices, the marketed milk increased with the years - in spite of no change in the number of livestock. 44.9% of all drug costs were spent for antibiotics, 7.3% went to disinfectants, 13.1% to vitamins and nutrient supplements, 11.5 to hormones, and 10.9% to vaccines. The specific drug costs increased to almost 300% within three years: in 2000, they amounted to 17,400 HUF, which increased to 31,500 HUF by 2002. This can be explained by the substantial increase of antibiotics, vitamin and vaccine costs. The share of vitamins, nutrient supplements and vaccines have of all costs also increased substantially. The total drug costs for 1 litre milk increased from 3 HUF to 4.4 HUF. On this farm, the costs invested into mastitis treatment drugs generated a return in case an average 349.7 litres extra milk for each cow. The drug costs for 1 litre of milk increased, meaning the economic efficiency of drug usage decreased.

Szerémi [8] evaluated a dairy farm housing 1000 cows, based on comparing their production indices and drug costs. The amount of cows increased slightly between 2003 and 2005, which also caused milk production to increase. The drug costs for one cow was 17,716 HUF, amounting to 2.14 HUF for a litre of milk. Categorized by indication, the preventive drugs (vaccines, disinfectants) were the most significant (with 36.8%) on the farm. This was followed by drugs used to treat reproductive disorders (25.9%) and those used to treat mastitis with 23.3%. 41% of all costs were used for antibiotics. The amount of disinfectants was 24%, which is over three times as much as the previous data. Hormones took up 10% of the costs, whereas vaccines were accounted for 13%. Szerémi [8] detailed the preventive drugs and antibiotics categories according to indication and active substances. 45.9% of preventative drugs in this analysis were udder disinfectants, and 54% were drugs used for mastitis. According to the average data of analyses conducted at Hungarian dairy farms, total drug costs consist of 45.2% antibiotics, 12.8% disinfectants, 11.7% hormones, and 10.6% vaccines. 68.4% of antibiotics on average are used for udder treatment [3, 6, 7, 8, 9]. Based on the literature, we can say that the production indicators and drug costs are very varied. Therefore, we think that there's a very good opportunity for increasing economic efficiency via well-designed animal health programs.

3. Materials and methods

During the research field work, we analysed a southern Great Plains dairy farm, where an average of 732 cows were kept during the analysis timeframe. 70% of the animals were of pure Holstein Friesian breed, and the remaining were crossbreeds of Norwegian Reds. The dairy farm had six production stables, each with 120 cattle capacity and deep litter. Four of these are modern, large internal height ones outfitted with collaring machines. Before calving, cows are kept in a dry stable for 7-8 weeks, along with heifers in calves. Two weeks before the expected time of calving, the animals are moved to the preparation area, and into the calving area right before calving, which is in the same building. The stable is loose-housed with deep litter, well-lit, has a collaring machine, and contains crucibles for calving and operations. There are 5-10 cows waiting for calving in the calving area on average. 3 days after calving, if the cow is capable of production according to the checkups, it's released from the calving area, and led into production stable No. 1. Her state of health is monitored every day for 30 days after this. Calves are separated from their mothers 1 hour after birth, after they consumed at least 1.5 litres of colostrum. After this, the calves are raised in special cubicles until they're 10-14 days old, from where males are sold for further keeping. Heifers are moved to the new large internal height calf raiser constructed in 2013, which houses 12 × 20 calves total. The four compartments in the centre are outfitted with Westfalia milk feeders offering milk substitute from a pacifier for each group. 2-3 weeks after a selection process, they're moved to the calf group raising area with deep litter. When they reach 6-8 months of age, they're herded to the neighbouring stables for youngsters, from where they're conceived at 15 month age, in case their body size is adequate. After positive pregnancy check, they're sent to the neighbouring dry cow stables with the other cows.

The milking is done using an old Westfalia 2×9 fishbone milking machine with a low milk canal, until the new Gea carousel system milking house is installed by mid-2015. The cows, the young and the separated calves are fed with monodiet, the group feeding is done from feeding tables. The production group is fed two times a day, whereas the others are fed once a day. Refreshing and retracting the Total Mixed Ration (TMR) is done 4-5 times a day. The TMR is distributed using a 12 m^3 Eurocomp feeding car pulled by a tractor, linked to a computer and a scale. The feeding materials used on the farm are: corn silage, alfalfa silage, grass bale silage, green wheat, triticale bale silage, alfalfa hay, grass hay, sugar beet slices and sweet pickled corn by-products.

The owners of the farm find feeding very important with a high fibre content, constant compound and homogeneous TMR based on exceptional roughage. They also set the bedding exceptionally well. They don't aim for an outstanding milk production, however, their cows' life expectancy is high, while the mortality and culling are kept low. The herd is officially free of tuberculosis, brucellosis and leucosis, and leptospirosis does not take place. They sold many in-calf heifers to the post-Soviet states, and purchased young heifers and calves with exceptional genetics from the Netherlands to replace them.

In the first part of our analysis, we collected the production indices of the dairy farm for the 2012-2014 period. We calculated the average drug costs of the herd by multiplying their amounts with their net prices of the three years. This process was done in accordance with other references [3, 6, 7, 8, 9], and sorted them by year, product groups and indication. We analysed how the costs of antibiotics were in detail, based on indication and active substance. To facilitate comparisons, we calculated the annual drug costs for one cow and one litre of milk. We evaluated

the correlation between drug usage and production indices. We compared the milk production and reproductive parameters to the udder health and fertility treatment drug costs. We also compared the mortality rate with the total drug cost per cow, and the calf drug costs per calf to the calves' mortality rate. Afterwards, using all the collected data, we calculated the recovery of drug costs in the herd.

4. Results and discussion

4.1. Comparative analysis of production indices and drug costs on the dairy farm

We calculated the annual udder health drug cost per cow and the annual fertility treatment drug cost per cow, and compared them to the related production parameters. This way, we were able to analyse the efficiency of drug usage. When evaluating the efficiency of calf health management, we compared the annual drug costs per calf to the calves' mortality rate. In order to evaluate the total drug usage of the dairy farm, we compared the cows' mortality rate to the annual drug costs per cow.

4.1.1. Specific drug costs and production indices

The specific udder health drug costs are the quotient of the annual udder health drug cost, and the quantity of marketed milk in a year. When calculating the annual fertility treatment drug cost, the given year's amount of drugs used to treat reproductive disorders has to be divided by the total number of progeny (calves) [3].

Table 1. Udder health and fertility treatment drug costs

Indicator	2012	2013	2014	Average
Marketed milk (l/year)	4,245,589	5,267,421	5,290,512	4,934,507
Total udder health drug cost (HUF/year/farm)	3,428,303	3,498,727	3,766,572	3,564,534
Udder health drug costs (HUF/l/year)	0.81	0.66	0.71	0.72
Progeny (calves/year)	681	639	842	721
Total fertility treatment drug cost (HUF/year/farm)	2,495,330	2,305,795	2,174,875	2,325,330
Fertility treatment drug costs (HUF/calf/year)	3,664	3,608	2,583	3,227

In the case of the specific udder health drug costs (Table 1.), we can see a 18.5% decrease in 2013, which was caused by a more than one million litres increase in milk production. However, the udder health drug costs per litre increased by 7.6% in 2014. This was caused by the increase in costs of udder treatments, while the milk produced that year was barely more than in the previous year. Compared to the average 0.72 HUF/l on this farm, the previous Hungarian surveys showed 0.6 l HUF/l/year [6] and 0.5 HUF/l/year [8] udder health drug cost/litre milk. These are 15-20% lower than our results. This difference might be because the dairy herd has lower than average lactatitional milk production. We can see how the status of udder health in the herd is unstable, since after the remarkable improvement in the middle year, it slightly deteriorated again in 2014. During the entire three year long period of the survey the milk production increased by nearly 25%, but the total drug cost barely increased by 10%, thus the specific udder health drug costs decreased by 12.3%.

The annual fertility treatment drug costs (Figure 1.) showed near identical data in the first two years - 3,664 HUF and 3,068 HUF per liveborn calf. However, in the third year, this index decreased by nearly 30% - to 2,583 HUF per calf, which was was caused by the 30% increase in the number of liveborn calves. The latter value is also a bit higher than the value calculated by Ózsvári et al. (2003) - 2,364 HUF/calf/year. The efficiency of drug usage to treat and prevent reproductive disorders in the surveyed three years is hard to evaluate. The company sold in-

calf heifers to the east multiple times, and purchased calves and in-calf heifers from the Netherlands. The evaluation of data was scrambled due to the calving of these animals that did not happen, or happened in excess. Anyway, the analyses say that if the herd fertility status deteriorates, the fertility treatment drug usage increases. If we also take the previously shown production data into consideration as well, we can see that due to the high number of pregnant heifers that calved, further increase in milk production is expected.

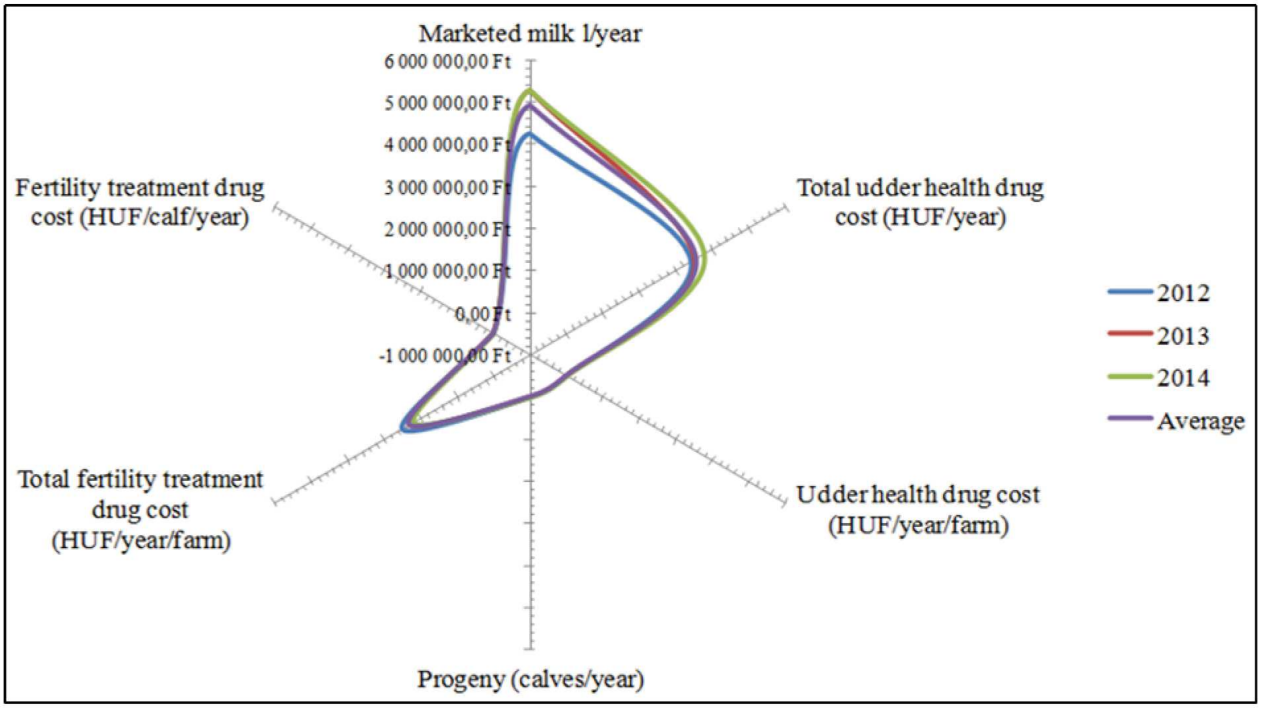

Figure 1. Trends in the annual fertility treatment and udder health drug costs

4.1.2. Correlations between drug costs and mortality rates

We also calculated the drug cost per calf, which is the quotient of the yearly costs of antibiotics used to treat calves and the annual progeny (Table 2.). After this, we evaluated the correlation between calf mortality rate and calf health management drug costs. We also calculated the costs of drugs used to prevent and treat diseases of calves until they became 6 months old, which was an average of 2,286 HUF.

Table 2. Annual total drug cost per calf/cow and mortality rates

Indexes	2012	2013	2014	Average
Calf mortality rate (%)	4,1	8,9	10,8	7,9
Antibiotics cost per calf (HUF/calf/year)	119	741	742	534
Drug cost per calf (HUF/6 month old calf/year)	1,708	2,562	2,588	2,286
Cow mortality rate (%)	4.1	2.6	3.4	3.4
Drug cost per cow (HUF/cow/year)	22,984	24,834	22,928	23,582
Cow culling rate (%)	18	21.2	19	19.4

The calf mortality rate increased by more than 116% in the second year of the analysis. The drastic increase (more than 520%) in the antibiotics cost cannot be verified by the mortality rate. The amount spent for antibiotics didn't increase significantly in 2014, but the mortality rate further deteriorated by 21.3%. Based on the evaluation, we can say that the calf raising technology, and its preventative and

treatment protocol have to be changed on this dairy farm. The annual total drug cost per cow on this dairy farm reached an average of 23,582 HUF. The analyses of Ózsvári et al. (2003) measured much less – 8,000 to 12,000 HUF on average – whereas Szerémi (2007) measured 17,716 HUF. Varga and Ózsvári (2004) also found a 31,500 annual total drug cost per cow in their analysis. The dairy farm showed a nearly identical value – 22,984 HUF and 22,928 HUF for 2012 and 2014 respectively – in our analysis. However, for the year 2013, the costs increased by more than 8% - up to 24,834 HUF. The average mortality rate for the three years was 3.4%, which is below the 5.2% value Ózsvári et al. (2003) calculated in their former analysis.

4.1.3. Return on drug costs

We calculated the return on drug costs in order to evaluate the financial efficiency of herd health management on the farm. As part of this, we calculated how much extra milk results from the total udder health drug costs, how many extra calves result from the total fertility treatment costs, and finally, how many litres of extra milk per cow is worth as much as the total drug cost per cow annually. The calculations required the average buy-up prices of raw milk in the given years. In the case of the dairy farm, this price was 89.6 HUF for 2012, 101.6 HUF for 2013, and 106.3 HUF for 2014. The market price of a suckling calf for the first two years was set to 45,000 HUF. In the third year, calves couldn't be sold in their first two weeks of their life, due to bluetongue outbreaks in Hungary. This resulted in a higher calf market value of 50,000 HUF which was used in the calculation for the year 2014. It is because of that the average market price of calves sold finally at the end of 2014 was higher, but their liveweight price per kilogram didn't even reach half of the previous suckling calf price, as those were sold when they were 8-15 weeks old. The data is summarized in Table 3.

Table 3. Return on drug costs

Indices	2012	2013	2014	Average
Udder health drug cost (HUF/cow/year)	4,862	5,085	4,684	4,877
Milk price (HUF/l)	89.6	101.6	106.3	99.2
Return (l/cow/year)	54.3	50.0	44.1	49.2
Fertility treatment cost (HUF/cow/year)	3,539	3,351	2,705	3,198
Market price of a calf (HUF/calf)	45,000	45,000	50,000	46,667
Return (calf/cow/year)	0.08	0.08	0.05	0.07
Drug cost per cow (HUF/cow/year)	22,984	24,834	22,928	23,582
Return (l/cow/year)	256.7	244.4	215.70	237.8

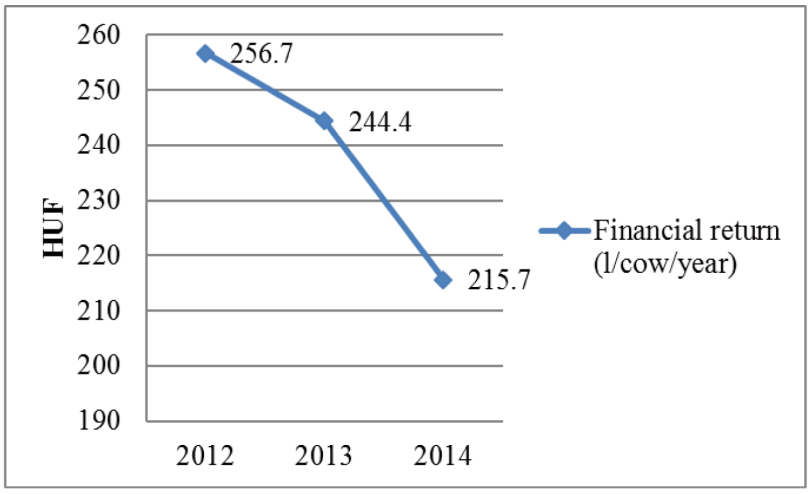

Figure 2. Return on total drug costs

The costs of udder health drugs generate a return in case of an excess milk of 42.9 l for each cow, which is much less than the amount either Ózsvári et al. (54.9-96.8) [6] or Szerémi (63.28) [8] calculated in their studies. One of the main reasons for this is that when we conducted our research, the price of milk was more than 50% higher. The buy-up price of raw milk constantly increased during the three years of

our analysis, while the costs of udder health drugs increased by 5% in the second year, but decreased by 8% in the third year. Based on all this, we can understand how the costs of drugs generated a return with much less extra milk. The higher costs of 2013 were compensated by the higher buy-up price of milk. The fertility treatment drug costs generate a return, if there's an annual 0.07 extra calf born per cow. This kind of cost decreased by 23.5% in the surveyed time period. As the market prices of calves only increased by 11%, we can explain how the number of extra calves required to recover the drug costs decreased from 0.07 to 0.05 calf/cow/year. The costs spent for fertility treatments in Ózsvári et al. [6] generated a return more easily, with 0.04 extra calves. However, Szerémi's [8] return was much higher, 0.12. The annual drug costs per cow for the three years generates a return for 237.8 litres of extra milk per cow. The drug costs per cow for 2013 were 8% higher compared to those of 2012 or 2014. The annual market price of milk increased each year, which caused the return to be generated even with nearly 16% less extra milk (Figure 2). The 349.7 l milk/cow/year annual figure calculated by Varga and Ózsvári [7] is substantially higher than that we calculated. However, Szerémi's [8] result of 279.4 l is much closer to the data we calculated in this analysis.

5. Conclusions

Summarily, we can conclude that apart from calf health management, the herd health management on the farm is adequate, and the drug costs are recovered quickly (though admittedly, the high milk prices also helped in the surveyed period). The goals of the dairy farm's management is to achieve the calf health management indices of 2012, the milk production parameters of 2013, and the number of cows and calvings of 2014 from 2015. The tight cooperation of experts on feeding, animal hygiene, milking, reproduction and herd health management is needed for completing these goals.

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